Argemone, by Dr. D. Prain, a description of a new species of *Bryopsis*, and of a peculiar mode of growth in another species, by Miss E. S. Barton; an account of fossil plant-remains in peat, by Mr. A. Gepp; and a description of a large number of new species of Orchidaceæ, by Mr. A. B. Rendle, from the plants brought by Mr. Scott Elliot from Tropical Africa.

SOCIETIES AND ACADEMIES.

London.

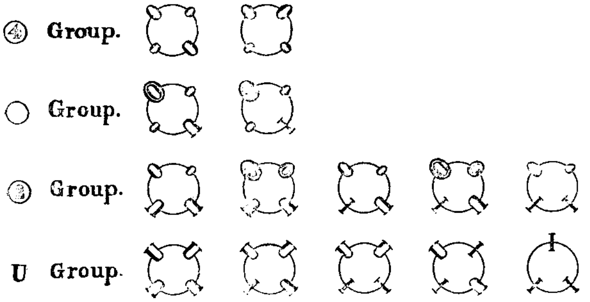
Royal Society, May 16.—"The Complete System of the Periods of a Hollow Vortex Ring." By H. C. Pocklington.

May 30.—"The Kinematics of Machines." By Prof. T. A. Hearson.

In this paper it is shown that all machine movements, however complex, are derived from the association together of some of a comparatively limited number of kinds of simple motions, which take place between consecutive directly connected pieces.

Certain geometrical laws are enunciated, from which are derived the conditions necessary for the association of those motions together in one machine. It is shown that those laws preclude the existence of certain combinations of motions. By attaching to each kind of motion a suggestive symbol a method of expressing the constitution of a machine movement by a simple formula is proposed, whereby similarities and differences between machines may be exhibited at a glance.

The author commences by considering a mechanism, consisting of four bars united in one continuous linkage by four pins which have parallel axes. By imagining the length of the links to undergo variation from zero to infinity, it is shown that this mechanism is representative of all the simple plane mechanisms, and, by imagining other variations to occur, it is shown to be representative of still further classes of mechanisms, in which the parts do not move in or parallel to one plane. In this the relative motions of consecutive pieces are either turning, when one piece revolves completely around relatively to the other, the representative symbol being the letter O, or swinging, when one piece turns through a limited angle relatively to the adjoining one, represented by the letter U.



The first law enunciated, which governs the association of the O and U motions, is founded on the geometrical fact that the sum of the four angles of the quadrilateral is constant. After a complete revolution the angle between the bars is considered to have been increased or diminished by 2π.

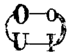
From this it is impossible for only one motion to be turning and the other three swinging, otherwise the sum of the four angles would increase or decrease by 2π each revolution.

The second law, which governs the association of the motions, has to do with the proportions between the length of the links necessary to permit of complete turning. This is founded on the fact that one side of a triangle cannot be greater than the sum of the other two. From these two laws together it is shown that it is impossible to have two Os alternating with two Us.

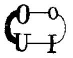
Next it is pointed out how the U motion may be provided for by constructing a circular slotway in one piece, and shaping the other piece to fit the slotway, so that by imagining the radius of curvature of the slotway to be indefinitely increased a relative movement of reciprocating sliding motion, represented by the symbolical letter I, will be substituted for the swinging motion U. A slide being conceived to be a swing through a zero angle about an infinitely distant centre, the previously mentioned laws will apply to associations containing I motions, and it will follow that a combination of three slides and one swing is precluded by the first law.

By the application of the governing laws 14 distinct combinations are found to be possible, and only 14. They are exhibited by the following formulæ, in which a large O associated with a small o signifies that in one case adjacent links turn relatively to one another so as to continuously increase the angle between them, and in the other to continuously diminish the angle. The double ◎ signifies that two complete revolutions accompany one complete to-and-fro swing or slide.

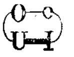
Applying Reuleaux's principle of "Inversion" it will be seen that 32, and only 32, distinct machine movements can be derived from the above 14 mechanisms. Those from the same mechanism are distinguished from one another in the formula by using a thick line for the frame link. For example,



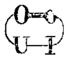
signifies a machine movement like that employed in the crank-and-connecting-rod engine.



is exemplified in the oscillating engine much used in paddle-wheel steamers.



is found in Stannah's pendulum pump, and



quadrupled is the movement adopted by Rigg in the design of his high speed engine.

The author next discusses the relation of cams and spur-wheel mechanisms to the foregoing kinematic chains, showing that they are the result of the suppression of one of the previous four links and the amalgamation of the two adjoining simple motions into one more complex. A comparison is also made with belt gearing, and expressive formulæ suggested.

The author then passes to the consideration of machines the parts of which do not move parallel to one plane.

The first 13 of the previously mentioned mechanisms have their counterpart in mechanisms the parts of which move parallel to the surface of a sphere. Hooke's joint is the best known example. The 14th consisting of 3 slides cannot be adapted to a sphere but it can to a cylinder, and from it are derived 4 possible screw mechanisms.

The remaining mechanisms consist of those in which the axes of the turning and swinging motions neither meet nor are parallel. They include the motion which occurs at a ball-and-socket joint. The method of classification according to the proposed scheme is summarised as follows:—

All simple machine movements may be ranged in four divisions, viz.:—

(1) Consisting of plane mechanisms, in which the pieces move in or parallel to the surface of a plane.

(2) Spherical mechanisms, in which the pieces move in or parallel to the surface of a sphere.

(3) Cylindrical mechanisms, in which the pieces move in or parallel to the surface of a cylinder.

(4) The remainder, to which the name conoidical mechanisms is given, in which the axes of the swinging and turning motions neither meet nor are parallel.

The mechanisms in each of these divisions are classed in two subdivisions.

Subdivision S, with surface contact of consecutive links.

Subdivision P, with point contact of consecutive links.

The mechanisms in each of the eight subdivisions are still further subdivided into combinations. The combinations of 1_s, 2_s, and 3_s, are exhaustively enumerated, and it is suggested that an extension of the methods of applying the geometrical laws would lead to the preparation of an exhaustive list of the possible combinations in the other subdivisions. The combinations are still further subdivided into inversions according to Reuleaux's principle of the inversion of a machine.

Lastly, the author proceeds to show how the foregoing considerations assist in the analysis of compound mechanisms. It is assumed that practically all compound mechanisms contain a continuous mechanism A, of not more than four links, from which definiteness of relative motion of all the other links is derived. Any two links of A in their exact length, or longer or shorter, may be adopted to form with two new links a second mechanism B, and any two of A or B, or one of A and one of B, may be adopted to form with two still further added links a third mechanism C, and so on. In this way a definiteness of relative motion of many links in a compound mechanism is derived. The notation lends itself to a clear exhibition of the manner in which two or more simple mechanisms are associated together, and the compound mechanism built up.

June 20.—"The Influence of the Cerebral Cortex on the Larynx." By Dr. J. S. Risien Russell.

The author found the condition of the peripheral laryngeal apparatus has practically no effect on the result obtained from the central nervous mechanism, for abduction or adduction of the vocal cords resulted on excitation of the appropriate area of the cerebral cortex, irrespective of whether abduction or adduction was obtained.on excitation of the recurrent laryngeal nerves in the same animal. No evidence of unilateral representation of the movements of the vocal cords in the cerebral cortex was obtained, although this point was tested in various ways. Nor was it found possible to inhibit the abductor muscles by excitation of the cortical centre of their antagonists the adductors. It was found that both in the dog and cat there existed a focus, excitation of which resulted in adduction of the vocal cords, and another near to this, stimulation of which resulted in abduction of the cords. While in the cat it was possible to differentiate these movements without any preliminary measures being adopted, it was only after the adductor fibres of one recurrent laryngeal nerve had been divided transversely that it first became possible to evoke abduction of the vocal cords on excitation of the cortex, though in subsequent experiments it was sometimes possible to evoke this movement on excitation of the cortex of the dog without adopting this preliminary measure. The other effect on the cords, which it was as a rule found most difficult to differentiate from that of abduction, was acceleration of their movements. It was further found that on the anterior composite gyrus, below the abductor centre, there existed a focus, excitation of which resulted in a clonic adductor effect on the cords, in which the cords were first brought into a position of moderate adduction, and then there was added rapid short to-and-fro excursions. On passing within the confines of Spencer's area for arrest of respiration, it was found that in the peripheral parts of this area there existed three foci, excitation of which affected the cords in different ways. The most anterior was responsible for arrest of the cords in adduction, *i.e.* in the expiratory stage of their excursions; excitation of the focus behind this, and corresponding, probably, to Horsley and Semon's abductor centre in the cat, was followed by arrest of the cords in abduction, *i.e.* their inspiratory position; while the most posterior focus, which is situated at about the junction of the anterior composite and anterior sylvian convolutions, resulted in intensification combined with acceleration of the movements of the cords when stimulated. Excitation of Spencer's chief focus for arrest of respiration on the olfactory lobe, resulted in arrest of the cords in the position they occupy during expiration in the dog, and in the position they occupy during inspiration in the cat.

Physical Society, June 28.—Dr. Gladstone, Vice-President, in the chair.—Mr. Bowden read a note on an electro-magnetic effect. A long glass tube containing mercury, and fitted with a small stand-pipe to indicate hydrostatic pressure, is passed between the poles of an electro-magnet. On passing a current of about 30 amperes through the mercury in this tube, the stand-pipe being turned so as to indicate the pressure either perpendicular or parallel to the lines of force of the field of the electro-magnet, movements of the mercury in the stand-pipe take place. When the stand-pipe is perpendicular to the lines of force of the field, the mercury rises or falls according to the direction of the current. When the stand-pipe, however, is parallel to the lines of force, the mercury always *rises*, whatever the direction of the current. Prof. S. P. Thompson said there appeared to be three unexplained effects, one proportional to the current and the field, and reversible; another, independent of the direction of the current, or of the field; and a third, which only occurred while the current was changing in strength. In addition there may be a fourth effect, which up to now has not been noticed. The motion of the mercury column in Fig. 1 of the paper was in the opposite direction to that of the drag on a conductor carrying the current. An apparent *rise* in pressure might be due to a decrease in the density of the mercury due to the heat developed by the current. Mr. Blakesley asked if the author had noticed any changes in level in the mercury reservoirs at the ends of the tube. The author, in his reply, said the reservoirs at the ends were so large that no changes of level were appreciable.—Mr. Rhodes read a paper on the armature reaction in a single phase alternating current machine. In this paper the author gives the investigations that were the subject of a verbal addendum to a paper read before the Society on a previous occasion. He investigates the lag or lead of the E.M.F.s over the current, and applies the results to examine whether the field excitation of the generator or the motor is strengthened or weakened by the reaction of the armature currents. Mr. Tunzelmann expressed a hope that the author would amplify parts of his paper. Mr. Blakesley said the conclusion of the author that "either of two alternate current machines may be driven as a motor by the other, irrespective of their relative E.M.F.s," is not invariably correct. The facts of the case were these: the E.M.F. of the motor may exceed that of the other machine to a certain extent; but that E.M.F., multiplied by the cosine of the angle of electric lag, must yield a product not greater than the E.M.F. of the generator; *i.e.* using Mr. Rhodes' symbols $e \cos \theta$ must not be greater than E. Mr. Blakesley gave a geometrical proof of this, but the same proposition had been given by him some ten years ago in the course of investigating the subject generally. This was at a time when Dr. John Hopkinson was, with less than his usual perspicuity, teaching that synchronous alternate current machines could not be run in series with stability, both doing work. Referring to the author's diagrams, Mr. Blakesley said that in a problem involving so many elements as that under consideration, it was impossible with the limited dimensions of space to represent the results with the complete generality of a formula. Some elements had to be taken as the independent, others as the dependent variables. The author had considered the power transmitted to the motor, the E.M.F. of the generator and the angle of electric lag as independent. The E.M.F. of the motor was dependent. In Mr. Blakesley's original diagrams the E.M.F.s were both considered independent as well as the electric lag, and the powers applied or transmitted as dependent variables. In any case the formulæ properly derived from such diagrams became perfectly general, and it did not appear to him that the change of method indicated could properly be called a new theory on the subject. As a matter of fact, diagrams based on the independence of the E.M.F.s and the electric lag would furnish a better means of discussing the question of the stability of the motion than Mr. Rhodes' plan, and this might account for the entire omission from the paper of this important matter. Prof. S. P. Thompson said it was impossible to discuss the question of stability till the subject of armature reaction had been thoroughly investigated. The terms lag and lead had been used by Mr. Rhodes in a consistent manner; but this was not always done, and he recommended that the phase of the current which was common to both generator and motor be taken as the standard. The author, in his reply, said he agreed with Mr. Blakesley that there was a limit to the extent to which the motor might be excited, and this upper limit could easily be obtained from the figure given in the paper. The question of armature reaction was, however, most important, as it might excite the field two or three times more than the original excitation. Since motors were designed to do a certain amount of work, and not the work to fit the motor, it was most natural to take the output of the motor as fixed.—Mr. Shelford Bidwell read a paper on the electrical properties of selenium. The author has continued his investigations on this subject, and has come to the following conclusions: (1) The conductivity of crystalline Se appears to depend principally on the impurities which it contains in the form of metallic selenides. It may be that the selenides conduct electrolytically, and that the influence of light in increasing the conductivity is to be attributed to its property of facilitating the combination of Se with metals in contact with it. (2) A Se cell having platinum electrodes, and made with Se to which about 3 per cent. of cuprous selenide has been added is, even though unannealed, greatly superior both in conductivity and sensitiveness to a similar cell made with ordinary Se and annealed for several hours. (3) Red Se in contact with copper or brass, is quickly darkened by the action of light, owing, it is suggested, to the formation of a selenide. (4) Crystalline Se is porous and absorbs moisture from the air, and it is this moisture that causes the polarisation of Se after the passage of a current. (5) The presence of moisture is not essential to sensitiveness, but appears to be in a slight degree favourable to it. (6) If cuprous selenide is made the kathode in an electrolytic cell, and a strip of platinum the anode in water, red Se mixed with detached particles of the selenide is deposited in the water. (7) The photo-electric currents sometimes set up when light falls upon Se, are dependent upon the presence of moisture, and are no doubt of voltaic origin. (8) Perfectly dry Se is below platinum in the thermo-electric series. Prof. Minchin (communicated) suggested that the selenium "cell" should be called a selenium "resistance." A grid having one terminal made of aluminium and the other of copper, might form a true cell, and might generate an E.M.F. when light fell on it. He (Prof. Minchin) would like to know if the author had tried any such cell in which light simply and solely generated an E.M.F. He could not agree that chemical action must necessarily follow the action of light in a cell. For, take the case of the oldest photo-electric cell—the thermopile—what chemical action can we show here for all the energy of the incident heat. Chemical action due to light may, or may not, occur according to the nature of the cell. Mr. Appleyard asked whether the author had submitted these selenium resistances to the action of electric oscillations. Prof. Minchin's "impulsion" cells were greatly influenced by electric oscillations. The great variation in the resistance with time of the author's cells pointed rather to an effect of contact between the selenium and the electrodes, than to an elementary change in the structure or composition. He (Mr. Appleyard) had recently tried to crystallise a supersaturated solution of sodium sulphate by electric oscillations, as well as by direct sparks, and by currents of several amperes, but no crystals could be induced to form. Change of contact, rather than change of structure, appeared to him to be the most promising direction in which to look for an adequate theory of selenium resistances. Prof. Ramsey said the quantity of Se liberated in the electrolytic experiment was much too great to be accounted for by oxygen dissolved in the water. The study of Se was very interesting, for this substance was on the borderland between those bodies in which the electric conduction was metallic, and those in which it was known to be electrolytic. The author, in his reply, said he agreed that the name "selenium cell" was not an appropriate one. He had not tried the effect of electric oscillations.—The Society then adjourned till the autumn.

Paris.

Academy of Sciences, July 1.—M. Marey in the chair.—The President announced the decease of Prof. Huxley, Correspondant of the Anatomy and Zoology Section.—On photographs of the moon and new objects discovered by means of them, by MM. Lœwy and Puiseux.—On an extensive class of linear partial differential equations, of which all the integrals are analytical, by M. Émile Picard.—Laws of extinction of a simple wave on the high seas, by M. J. Boussinesq. The coefficient of extinction (with the distance) of a simple wave is inversely proportional to the fifth power of its demiperiod T.—On the estimation of minute quantities of arsenic, by M. Ad. Carnot. The arsenic is separated in the usual manner as sulphide, this is dissolved in free ammonia and treated with silver nitrate and hydrogen peroxide. The solution is then precipitated by bismuth nitrate, followed by ammonia, the accompanying bismuth hydrate is dissolved out by nitric acid ($\frac{1}{15}$ nitric acid of sp. gr. 1·33), and, finally, the bismuth arsenate is dried at 110° and weighed.—Truffles (Terfâs) from Morocco and Sardinia, by M. Ad. Chatin.—Comparison of the heating of the muscles in the cases of positive and negative work, by M. A. Chauveau. During negative work, descent or lowering, the temperature of the muscles concerned was raised to a notably less degree than during corresponding positive work, ascent or raising.—Contribution to the study of arable soil. Quantities of air and water contained in clods of earth, by M. P. P. Dehérain.—On the products of oxidation of benzylidenecamphor and benzylcamphor. Nitrosate or nitronitrite of benzylidenecamphor, by M. A. Haller.—A new instrument (tachéograph) serving to survey and trace directly from the earth's surface, by M. Schrader.—On curves traced on a surface, of which the osculating sphere is tangential at each point to the surface, by M. E. Cosserat.—On linear equations to the derived partials, by M. Étienne Delassus.—On the integration of ordinary differential equations, by M. Alf. Guldberg.—On the propagation of sound in a cylindrical tube, by MM. J. Violle and Th. Vautier.—On the apparent attractions and repulsions of electrified conductors in a dielectric fluid, by M. Gouy. The apparent forces exercised between conductors with given charges in a liquid dielectric result: (1) from their mutual attractions and repulsions, the same as in a vacuum; (2) from the hydrostatic pressure produced by the force which attracts the dielectric in the sense where the intensity of the field increases most rapidly.—New method of measurement of electric capacities based on the sensitiveness of the skin, by M. H. Bordier.—On the solubility of superfused liquids, by M. Louis Bruner. The author finds that superfused sodium thiosulphate is much more soluble in alcohol than the corresponding solid compound.—On the specific heat of superfused salts, by M. Louis Bruner. The curve of specific heats at different temperatures for sodium thiosulphate shows a maximum near the point of fusion, 48° C.—On paratungstic acid, by M. L. A. Hallopeau.—On the estimation of alumina in phosphates, by M. Henri Lasne. A method of precipitation of pure aluminium phosphate is described, which avoids the complications introduced by the use of molybdate or citrate in estimating alumina. The precipitation is accomplished by the use of ammonium thiosulphate.—On sodammonium, by M. de Forcrand. A thermo-chemical study.—On the phosphoric esters of allyl alcohol, allylphosphoric acid, by M. J. Cavalier.—Preparation and conductibility of new methyl alkylcyanacetates, by M. J. Guinchant.—Verification of Tschermak's law relative to plagioclases, and a new process of orientation and of diagnosis of felspars in thin plates, by M. A. Michel-Lévy.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Books.—Matriculation Directory, No. xviii., June, 1895 (University Correspondence College).—Allen's Naturalist's Library. A Hand-book to the Game Birds, Vol. 1: W. R. Ogilvie-Grant (Allen).—Missouri Botanical Garden, Sixth Annual Report (St. Louis, Mo.).—Iowa Geological Survey, Vol. 3, 2nd Annual Report, 1893 (Des Moines).—An Analysis of Astronomical Motion: Dr. H. Pratt (Norman).—Report of the International Meteorological Congress held at Chicago, Ill., August 21-24, 1893, Part 2 (Washington).—Ice-Bound on Kolguev: A. Trevor-Battye (Constable).—Wild England of To-day: C. J. Cornish (Seeley).—Thirteenth Annual Report of the Fishery Board for Scotland. Part 1. General Report (Edinburgh).

Pamphlets.—Report on the Loss of Gold in the Reduction of Auriferous Veinstone in Victoria: H. Rosales (Melbourne).—Royal Gardens, Kew, Hand-list of Herbaceous Plants (Eyre).—Great Eastern Railway Company's Tourist Guide to the Continent (30 Fleet Street).

Serials.—Geological Magazine, July (Dulau).—Scribner's Magazine, July (Low).—Jahrbuch der K.K. Geologischen Reichsanstalt, Jahrgang 1894, xliv. Band, 2, 3, and 4 Heft (Wien).—L'Anthropologie, Tome vi. No. 3 (Paris).—Science Progress, July (Scientific Press, Ltd.).—Proceedings of the Bath Natural History and Antiquarian Field Club, Vol. 8, No. 2 (Bath).—Annals of Scottish Natural History, July (Edinburgh, Douglas).—Journal of the Sanitary Institute, July (Stanford).—Himmel und Erde, July (Berlin).—Blackwood's Magazine, July (Blackwood).—Transactions of the Leicester Literary and Philosophical Society, April (Leicester).—Mind, July (Williams).—Botanische Jahrbücher, Zwanzigster Band, 5 Heft (Leipzig).

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